

Comment on “the decoupling of heavy sneutrinos in low-scale seesaw models”

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The authors of a recent communication [arXiv:1312.5318] claim to have traced an error in the existing literature regarding the evaluation of the one-loop right-handed sneutrino contributions to lepton-flavour-violating observables in supersymmetric low-scale seesaw models. In this short note, we emphasize that contrary to those authors’ claim, our paper [arXiv:1212.5939] contains no such a flaw, and both our analytical and numerical results exhibit the expected decoupling property of the heavy sneutrinos in the Z -penguin graphs.

In the Introduction of a recent communication [1], the authors are quoting our paper [2], by stating that we have “confirmed” the dominance of Z -penguins contributions “in most parts of parameter space.” However, this is an inaccurate statement, since we have only considered *one point* in the mSUGRA parameter space, namely

$$\tan \beta = 10, \quad m_0 = 1000 \text{ GeV}, \quad A_0 = -3000 \text{ GeV}, \quad M_{1/2} = 1000 \text{ GeV}.$$

These input parameters are defined in Eq. (4.1) of [2] and are kept fixed in all our numerical estimates, except when we were considering the dependence of the lepton-flavour-violating observables on $\tan \beta$.

The expected decoupling behaviour of the sneutrino Z -penguin contributions to $\text{BR}(\mu \rightarrow 3e)$ should occur for large values of M_{SUSY} . In our mSUGRA framework, this corresponds to $M_{\text{SUSY}} = m_0 = M_{1/2}$. We have numerically checked the behaviour of the chargino-sneutrino contribution to the Z penguin graphs, and confirmed the existence of the decoupling for large values of M_{SUSY} , as shown in Fig. 1. Hence, our results are in good agreement with those given in Fig. 1 of [1].

As a source of the allegedly common mistake in the literature, the authors of [1] identify this to be the chargino contributions to the form factor F_L given in Ref [3]. They remark that the mistake arises due to the incorrect use of a relation between Passarino–Veltman integrals, which was adopted in [4]. In particular, the relation $DC_{00} = 4C_{00}$ should read: $DC_{00} = 4C_{00} - \frac{1}{2}$. However, in our paper [2], we did not use this relation, but we have independently calculated all the necessary loop integrals, which are *explicitly* listed in Appendix B. This technical mistake does not occur in our paper, as it was further detailed in [5].

In conclusion, both our analytical and numerical results in [2] exhibit the expected decoupling property of the heavy sneutrinos in the Z -penguin graphs, and are in good agreement with the results presented in [1].

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- [1] M. E. Krauss, W. Porod, F. Staub, A. Abada, A. Vicente and C. Weiland, arXiv:1312.5318 [hep-ph].
 - [2] A. Ilakovac, A. Pilaftsis and L. Popov, Phys. Rev. D **87**, no. 5, 053014 (2013) [arXiv:1212.5939 [hep-ph]].
 - [3] E. Arganda and M. J. Herrero, Phys. Rev. D **73**, 055003 (2006) [hep-ph/0510405].
 - [4] E. Arganda, A. M. Curiel, M. J. Herrero and D. Temes, Phys. Rev. D **71**, 035011 (2005) [hep-ph/0407302].
 - [5] L. Popov, PhD thesis (Zagreb, 2013) arXiv:1312.1068 [hep-ph], pp. 73–78.

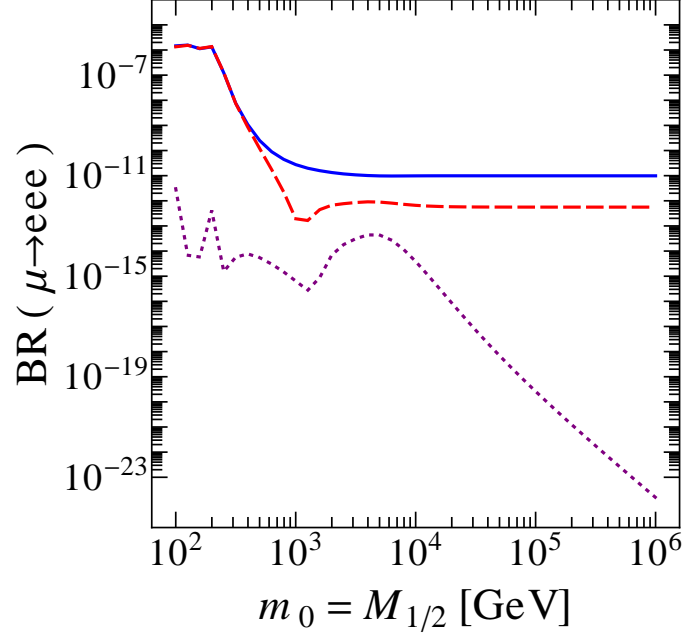


FIG. 1: Numerical estimates of $\text{BR}(\mu \rightarrow 3e)$ as a function of the mSUGRA parameter $M_{\text{SUSY}} = m_0 = M_{1/2}$, for a fixed value of the heavy neutrino/sneutrino mass: $m_N = 1$ TeV. The (blue) solid line gives the total contribution to $\text{BR}(\mu \rightarrow 3e)$, the (red) dashed line indicates the contribution from the photon penguin graph only, whereas the (purple) dotted line gives the sneutrino contribution to the Z penguin diagrams.